

IN THE CLAIMS

Cancel Claims 1 - 35 and add new Claims 36 - 95 so that the claims are as follows:

1 - 35 (Canceled)

36. A receiver system comprising:

a group of one-dimensional ("1-D") receivers each comprising (a) an input section that processes a corresponding different one of a group of receiver input signals respectively corresponding to the receivers according to a process that comprises serially filtering and digitizing that input signal to generate a corresponding processed signal as a stream of filtered digitized values and (b) an equalizer that performs equalization on an intermediate signal comprising the filtered digitized values or further values generated from the filtered digitized values to produce a corresponding equalized signal as a stream of equalized values;

a group of 1-D symbol selectors respectively corresponding to the receivers, each symbol selector providing a corresponding symbol signal as a stream of 1-D symbols chosen, from a set of predefined 1-D symbols, to be respectively substantially closest to the equalized values of the equalized signal of the corresponding receiver, data for a feedback signal used by the equalizer in each receiver for generating the current equalized value of that receiver's equalized signal being supplied from a lookup table as a function of at least one previous symbol provided from the corresponding symbol selector; and

a multi-dimensional decoder that furnished a stream of multi-dimensional symbols in response to the streams of 1-D symbols.

37. A system as in Claim 36 wherein the equalizers alleviate intersymbol interference in the receiver input signals.

38. A system as in Claim 36 wherein the feedback signal used by the equalizer in each receiver is supplied from the lookup table for that feedback signal as a function of at least the immediately previous symbol provided from the corresponding symbol selector.

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39. A system as in Claim 36 wherein the feedback signal used by the equalizer in each receiver is supplied from the lookup for that feedback signal as a function of multiple previous symbols provided from the corresponding symbol selector.

40. A system as in Claim 36 wherein the feedback signal used by the equalizer in each receiver is supplied from the lookup table for that feedback signal as a function of multiple consecutive previous symbols, including the immediately previous symbol, provided from the corresponding symbol selector.

41. A system as in Claim 36 wherein the equalizer of each receiver produces its equalized signal by negatively adding that equalizer's feedback signal to the corresponding intermediate signal or to an additional signal produced from the corresponding intermediate signal.

42. A system as in Claim 36 wherein the equalizer in each receiver comprises:  
a pre-equalizer which generates a partially equalized signal in response to the corresponding intermediate signal;  
a feedback circuit which generates the feedback signal for that receiver's equalizer;  
and  
an arithmetic element which produces that receiver's equalized output signal by negatively adding the feedback signal for that receiver's equalizer to the partially equalized signal.

43. A system as in Claim 42 wherein, in generating the current equalized value of the equalized output signal of each receiver, the pre-equalizer in that receiver provides equalization on at least one selected value of that receiver's processed signal where each selected value corresponds to a signal provided by the corresponding symbol selector prior to each symbol used in generating the feedback signal for that receiver's equalizer.

44. A system as in Claim 36 wherein:  
each symbol selector also generates an error signal as an accuracy estimate for that symbol selector's symbol signal;

the system further includes (a) an error correction circuit responsive to the error signal for generating an error result signal that indicates which of the current equalized

values of the equalized signals is most likely incorrect and (b) a parity check circuit responsive to the symbol signals for supplying a parity signal that indicates whether each multi-dimensional is of correct parity; and

the multi-dimensional decoder also operates in response to the parity and error result signals for modifying the multi-dimensional symbols in accordance with the current equalized value of the equalized signal most likely to be incorrect if the parity signal indicates a parity error.

45. A system as in Claim 36 wherein the receivers include coefficient update circuitry for adaptably changing equalization parameters for the equalizers. *RW*

46. A system as in Claim 36 wherein the input section of each receiver comprises a filter and an analog-to-digital converter coupled together in series.

47. A system as in Claim 46 wherein the filters have echo cancellation capability.

48. A system as in Claim 46 wherein the filters have near-end crosstalk cancellation capability.

49. A system as in Claim 46 wherein the filters have anti-aliasing capability.

50. A system as in Claim 46 wherein each receiver includes an amplifier coupled in series with that receiver's filter and analog-to-digital converter.

51. A system as in Claim 36 wherein the receivers have baseline wander correction capability.

52. A receiver system comprising:

a group of one-dimensional ("1-D") receivers, each comprising (a) an input section that processes a corresponding different one of a group of receiver input signals respectively corresponding to the receivers according to a process that comprises serially filtering and digitizing that input signal to generate a corresponding processed signal as a stream of filtered digitized values and (b) a sequence detector that performs sequence detection on an intermediate signal constituted with intermediate values comprising the filtered digitized

values or further values generated from the filtered digitized values to approximate sequences of the intermediate values, as sequences, to respectively corresponding sequences of 1-D symbols chosen from a set of predefined 1-D symbols and to provide the sequences of 1-D symbols as a stream of 1-D symbols; and

a multi-dimensional decoder that furnishes a stream of multi-dimensional symbols in response to the streams of 1-D symbols.

53. A system as in Claim 52 wherein the sequence detectors alleviate intersymbol interference in the receiver input signals.

54. A system as in Claim 52 wherein each sequence detector comprises:

a branch metric generator which generates an array of branch metrics for each predefined 1-D symbol for that sequence detector at a  $k$ th time period that immediately follows a  $(k-1)$ th time period where each branch metric is a measure of how much one of the intermediate values to that sequence detector at the  $k$ th time period differs from a transition value for a transition to that predefined 1-D symbol at the  $k$ th time period along an allowable path from each different one of the predefined 1-D symbols at the  $(k-1)$ th time period;

a determining/comparing circuit which (a) determines a state metric for each predefined 1-D symbol at the  $k$ th time period with respect to the intermediate value to that sequence detector at the  $k$ th time period and (b) generates a comparison result indicating which state at the  $(k-1)$ th time period for each predefined 1-D symbols results in the state metric for that predefined 1-D symbol at the  $k$ th time period; and

a detector output circuit which provides a sequence of the 1-D symbols based on the comparison results.

55. A system as in Claim 54 wherein the determining/comparing circuit of each sequence detector determines its state metrics at the  $k$ th time period by a process that entails determining the minimum of a group of sums for each predefined 1-D symbol where each sum is the sum of (a) one of the branch metrics for that predefined 1-D symbol at the  $k$ th time period and (b) the associated state metric at the  $(k-1)$ th time period.

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56. A system as in Claim 54 wherein each sequence detector includes a starting point determining circuit which determines a starting state in response to the state metrics for that sequence detector.

57. A system as in Claim 54 wherein the branch metric generator in each sequence detector employs the comparison results for that sequence detector in generating the branch metrics for that sequence detector.

58. A system as in Claim 54 wherein the determining/comparing circuit of each sequence detector generates for each predefined 1-D symbol at the kth time period (a) a best state metric and a second-best state metric, (b) a best comparison result and a second-best comparison result, and (c) a difference result as a measure of how much the best state metric differs from second-best state metric.

59. A system as in Claim 58 wherein the multi-dimensional decoder utilizes the best comparison, second-best comparison, and difference results to correct any errors in the stream of multi-dimensional symbols.

60. A system as in Claim 58 wherein the multi-dimensional decoder comprises:  
a group of read modules respectively corresponding to the sequence detectors, each read module operating in response to the best comparison, second-best comparison, and difference results for the corresponding sequence detector at the kth time period to generate a best one of the predefined 1-D symbols at the kth time period, a second-best one of the predefined 1-D symbols at the kth time period, and a associated reliability measure at the kth time period;

a parity check circuit which, in response to the best predefined 1-D symbols at the kth time period, generates a parity signal for the kth time period;

an error analysis circuit which operates in response to the reliability measures at the kth time period to generate an error indication signal for the kth time period to indicate which of the best predefined 1-D symbols at the kth time period is most likely to be incorrect; and

a decoder circuit which, in response to the best predefined 1-D symbols at the kth time period, the second-best predefined 1-D symbols at the kth time period, the parity signal for the kth time period, and the error indication signal for the kth time period, determines

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final ones of the predefined 1-D symbols for the kth time period and generates a corresponding multi-dimensional symbol for the kth time period.

61. A system as in Claim 60 wherein each read module operates in response to the final predefined 1-D symbols at the kth time period for the corresponding sequence detector to determine a best one of the predefined 1-D symbols at the (k-1)th time period, a second-best one of the predefined 1-D symbols at the (k-1)th time period, and an associated reliability measure at the (k-1)th time period.

62. A system as in Claim 60 wherein the branch metric generator employs the comparison results in generating the branch metrics.

63. A system as in Claim 62 wherein each sequence detector employs reduced complexity sequence detection.

64. A system as in Claim 52 wherein there are at least five different predefined 1-D symbols.

65. A system as in Claim 52 wherein each 1-D receiver includes a pre-equalizer that performs equalization on the filtered digitized values of that receiver's processed signal to generate the intermediate values of that receiver's intermediate signal as partially equalized values.

66. A system as in Claim 55 wherein each pre-equalizer employs feedforward equalization.

67. A system as in Claim 65 wherein coefficients for the pre-equalizers are adaptively chosen.

68. A system as in Claim 52 wherein the input section of each receiver comprises a filter and an analog-to-digital converter coupled together in series.

69. A system as in Claim 68 wherein the filters have echo cancellation capability.

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70. A system as in Claim 68 wherein the filters have near-end crosstalk cancellation capability.
71. A system as in Claim 68 wherein the filters have anti-aliasing capability.
72. A system as in Claim 68 wherein each receiver includes an amplifier coupled in series with that receiver's filter and analog-to-digital converter.
73. A system as in Claim 52 wherein the receivers have baseline wander correction capability.
74. A method of receiving a group of input signals transmitted over respectively corresponding channels, the method comprising:
- processing each input signal according to a process that comprises serially filtering and digitizing that input signal to generate a corresponding processed signal as a stream of filtered digitized values;
  - performing equalization on an intermediate signal comprising the filtered digitized values or further values generated from the filtered digitized values to produce a corresponding equalized signal as a stream of equalized values;
  - generating, for each equalized signal, a corresponding symbol signal as a stream of one-dimensional ("1-D") symbols chosen, from a set of predefined 1-D symbols, to be respectively substantially closest to the equalized values of that equalized signal;
  - accessing, for use in producing a feedback signal utilized in generating the current value of each equalized signal, a lookup table to obtain data as a function of at least one previous symbol of the corresponding symbol signal; and
  - decoding the streams of 1-D symbols to produce a stream of multi-dimensional symbols.
75. A method as in Claim 74 wherein each feedback signal is produced by obtaining, from the lookup table for that feedback signal, data as a function of multiple previous symbols of the symbol signal generated from the corresponding equalized signal.

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76. A method as in Claim 74 wherein the equalization-performing and table-accessing acts comprise negatively adding each feedback signal to the corresponding intermediate signal or to an additional signal produced from the corresponding intermediate signal.

77. A method as in Claim 74 wherein the equalization-performing and table-accessing acts include:

performing, in generating the current equalized value of each equalized signal, equalization on at least one selected value of the corresponding intermediate signal to generate a corresponding partially equalized signal where each selected value corresponds to a symbol of the corresponding symbol signal provided prior to each symbol used in generating the corresponding feedback signal; and

negatively adding each feedback signal to the corresponding partially equalized signal.

78. A method as in Claim 74 further including:

generating an error signal as an accuracy estimate for each symbol signal;

generating an error result signal that indicates which of the current values of the equalized signals is most likely incorrect;

supplying a parity signal indicating whether each multi-dimensional symbol is of correct parity; and if the parity signal indicates a parity error,

modifying the multi-dimensional symbols in accordance with the current equalized value of the equalized signal most likely to be incorrect.

79. A method as in Claim 74 further including adaptively generating coefficients to change algorithms for generating the equalized signals.

80. A method as in Claim 74 wherein the signal-processing act includes amplifying each input signal.

81. A method as in Claim 74 wherein the filtering of the input signals includes utilizing one or more of echo cancellation, near-end crosstalk cancellation, and anti-aliasing.

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82. A method of receiving a group of input signals transmitted over respectively corresponding channels, the method comprising:

processing each input signal according to a process that comprises serially filtering and digitizing that input signal to generate a corresponding processed signal as a stream of filtered digitized values;

performing, for each processed signal, sequence detection on a corresponding intermediate signal constituted with intermediate values comprising the filtered digitized values of that processed signal or further values generated from the filtered digitized values of that processed signal to approximate sequences of those intermediate values, as sequences, to respectively corresponding sequences of one-dimensional ("1-D") symbols chosen from a set of predefined 1-D symbols and to provide the sequences of 1-D symbols as a stream of 1-D symbols; and

decoding the streams of 1-D symbols to produce a stream of multi-dimensional symbols.

83. A method as in Claim 82 wherein, for each intermediate signal, the sequence-detection-performing act comprises:

generating an array of branch metrics for each predefined 1-D symbol at a kth time period that immediately follows a (k-1)th time period where each branch metric is a measure of how much one of the intermediate values associated with that intermediate signal at the kth time period differs from a transition value for a transition to that predefined 1-D symbol at the kth time period along an allowable path from each different one of the predefined 1-D symbols at the (k-1)th time period;

determining a state metric for each predefined 1-D symbol at the kth time period with respect to the intermediate value of that intermediate signal at the kth time period;

generating a comparison result indicating which state at the (k-1)th time period for each predefined 1-D symbol results in the state metric for that predefined 1-D symbol at the kth time period; and

providing a sequence of 1-D symbols based on the comparison results.

84. A method as in Claim 83 wherein, for each intermediate signal, the state-metric-determining act comprises determining the minimum of a group of sums for each predefined 1-D symbol where each sum is the sum of (a) one of the branch metrics for that predefined

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1-D symbol at the  $k$ th time period and (b) the associated state metric at the  $(k-1)$ th time period.

85. A method as in Claim 83 further including, for each intermediate signal, determining a starting state in response to the state metrics.

86. A method as in Claim 83 wherein, for each intermediate signal, the branch-metric-generating act includes employing the comparison results in generating the branch metrics.

87. A method as in Claim 83 further including, for each intermediate signal, generating for each predefined 1-D symbol at the  $k$ th time period (a) a best state metric and a second-best state metric, (b) a best comparison result and a second-best comparison result, and (c) a difference result as a measure of how much the best state metric differs from second-best state metric.

88. A method as in Claim 87 further including utilizing the best comparison, second-best comparison, and difference results to correct any errors in the stream of multi-dimensional symbols.

89. A method as in Claim 87 wherein the decoding act comprises:

generating, for each intermediate signal, a best one of the predefined 1-D symbols at the  $k$ th time period, a second-best one of the predefined 1-D symbols at the  $k$ th time period, and an associated reliability measure at the  $k$ th time period in response to the best comparison, second-best comparison, and difference results for that intermediate signal at the  $k$ th time period;

generating a parity signal for the  $k$ th time period in response to the best predefined 1-D symbols at the  $k$ th time period;

generating an error indication signal for the  $k$ th time period in response to the reliability measures at the  $k$ th time period to indicate which of the best predefined 1-D symbols at the  $k$ th time period is most likely incorrect;

determining final ones of the predefined symbols for the  $k$ th time period in response to the best predefined 1-D symbols at the  $k$ th time period, the second-best predefined

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symbols of the kth time period, the parity signal for the kth time period, and the error indication signal for the kth time period; and

generating a corresponding multi-dimensional symbol for the kth time period.

90. A method as in Claim 89 further including, for each intermediate signal, determining a best one of the predefined 1-D symbols at the (k-1)th time period, a second-best one of the predefined 1-D symbols at the (k-1)th time period, and an associated reliability measure at the (k-1)th time period in response to the final predefined 1-D symbol at the kth time period.

91. A method as in Claim 82 wherein the sequence-detection-performing act comprises employing reduced complexity sequence detection.

92. A method as in Claim further including, for each processed signal, performing equalization on the filtered digitized values of that processed signal to generate the intermediate values of the corresponding intermediate signal as partially equalized values.

93. A method as in Claim 92 wherein the equalization comprises feedforward equalization.

94. A method as in Claim 92 wherein the signal-processing act includes amplifying each input signal.

95. A method as in Claim 92 wherein the filtering of the input signals includes utilizing one or more of echo cancellation, near-end crosstalk cancellation, and anti-aliasing.

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